TERRAMODEL NOTE 6
Stage-Storage Calculations

Objective--

The objective of this TM Note is to outline a procedure to calculate a stage-storage table. The calculations are based on the average end area method using the contour lines generated from your model.

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TERRAMODEL Note 6--Stage Storage Calculations

To calculate a stage-storage table, the Inpond and Pondvol commands will be used. When performing stage-storage calculations, closed polylines (or areas) should be used. Also, "non-smoothed" contours should be used. The contour lines should be manipulated manually so they reflect the areas that would be manually planimetered. The steps are as follows:

1. Copy the POINTS layer to a layer named STAGE
2. Lock and turn off the visibility of all layers except for the STAGE layer
3. Contour using the STAGE layer as the DTM layer
4. Draw the centerline
5. Clip the contour lines at centerline
6. Erase everything downstream of the centerline
7. Erase the points and contours above the desired elevation
8. Close the contour lines along centerline
9. Create a point for use with the Inpond command
10. Run the Inpond command to define the pond area
11. Run the Pondvol command to calculate the stage-storage table

This tutorial will use the project file **chapter6.pro**, which can be found on the FTP server. This is a contour map that has already been created. The breaklines have been added and the benchmark has been placed on a layer named BM. It is important to have a good topography map before you attempt to create a stage-storage table. Open the TERRAMODEL program; then open the project **chapter6.pro**.

Once the project is open, save the project as a different file name so that the original file can be used at a later time.

1. Copy the POINTS layer to a STAGE layer

Before copying the points to the STAGE layer, this layer must be created. Create a layer named STAGE with the same object and point colors as on the POINTS layer. Make the STAGE layer the current layer.

To copy the points:

[Edit]-[Copy]

Make sure the "Lay" check box is enabled. This will place the copied points on the current layer (the STAGE layer).

Change the select control to Layer. This can be done by pressing "L" on the keyboard when the focus is on the select control window, or by right-clicking in the drawing area and choosing Layer from the select control pop-up menu.

Chose the POINTS layer to be copied. This can be done by left-clicking on any object on the POINTS layer, or by left-clicking on the small button just to the right of the select control window and choosing the POINTS layer from the Select by layer(s) dialog box.

Leave the From and To windows blank so that the copied points will be placed in the same position as the original points.

On the command bar; **[OK]**

2. Lock and turn off the visibility of ALL layers except the STAGE layer

Locking and turning off the visibility of these layers will prevent accidental editing of the contents of these layers and keep them from cluttering up the screen. If the layer is invisible but not locked, the contents of that layer can still be accidentally changed. Therefore, it is important to lock any layer that you don't want altered.

In the toolbar; **[L Set]** This will bring up the Layer settings dialog box.

With the POINTS layer highlighted; Disable the "Visible" check box (remove the check) by left-clicking on it, and enable the "Lock" check box (turn on the check) by left-clicking on it.

Repeat that process for all of the other layers except the STAGE layer.

Note: It is not important for layer 0 to be locked, but it also doesn't hurt. Also, remember that multiple layers can be highlighted at once using the **{Shift}** or **{Ctrl}** key.

3. Contour using the STAGE layer as the DTM layer

When contouring, the contours must not be clipped around the labels because continuous contours must be used. Also, non-smoothed (straight line) contours should be used.

To contour the STAGE layer:

[DTM]-[Generate contours]

Change the DTM layer to the STAGE layer. This can be done by pressing "S" on the keyboard while the focus is on the DTM layer window, or by left-clicking on the down arrow just to the right of the DTM layer window and selecting the STAGE layer from the dialog box.

On the command bar; **[Settings]** This will bring up the Contour settings dialog box.

Disable the "Clip lines under labels" check box and the "Smooth contours" check box.

On the Contour settings dialog box; **[OK]**

On the command bar; **[OK]**

TERRAMODEL will now want to create the STAGE_CON layer. Choose color 3 for the object color, then, on the New layer dialog box **[OK]**.

TERRAMODEL will now want to create the STAGE_ICON layer. Choose color 2 for the object color, then, on the New layer dialog box **[OK]**.

4. Draw the centerline

The next step is to establish the centerline for your project. If you have identified centerline shots during your survey, you can use the labels to help you locate centerline. In the tutorial project, the two centerline shots that will be used to draw the centerline have the name PIN.

Create a new layer named CL with an object color of 9. Make CL the current layer.

Label only the points that have the name PIN

[Draft]-[Label points with text]

Change the select control to Name by pressing "N" on the keyboard or by right-clicking in the drawing area and selecting Name from the select control pop-up menu.

Right click on the button just to the right of the Select control window. This will bring up the Select by name dialog box.

In the Mask window; **PIN** (This is case sensative)

On the Select by name dialog box; **[OK]**

On the command bar; **[Settings]** This will bring up the Point label content dialog box.

Disable all check boxes except for the “Description” check box.

To the right of the Description check box; **[Edit]** This will bring up the Point description label settings dialog box.

Select the layer, color, height, etc. for the labels.

On the Point description label settings dialog box; **[OK]**

On the Point label content dialog box; **[OK]**

On the command bar; **[Label]**

Note: If the labels were placed on a layer that is not currently visible, they will not show up.

Note: Labeling the centerline shots is not necessary if you know where they are.

The two points that will be used to draw the centerline (labeled PIN) can be seen in Figure 6-1.

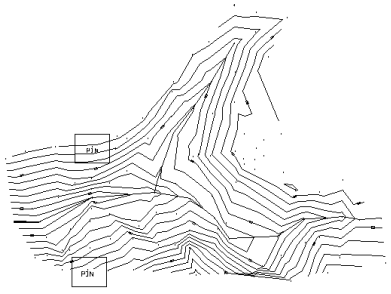

Figure 6-1

The Zoom command can be used to get a closer look at the points.

[View]-[Zoom]

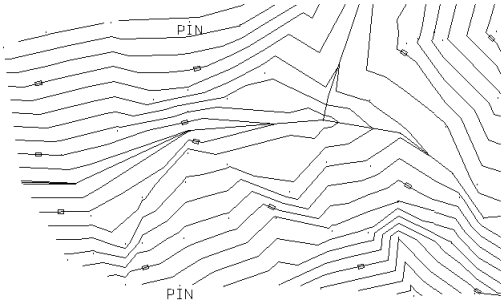

Figure 6-2

Draw a polyline connecting the centerline PIN's:

With the CL layer as the current layer: [Draw]-Pline-[Line]

With the cross hairs anywhere in the drawing window; hit the right mouse button. This will bring up the Point Snap Modes pop-up menu.

From the pop-up menu; select "Point" by left-clicking on it

With the pick-box over the first point; left-click to select that point

Again, with the cross hairs anywhere in the drawing window; hit the right mouse button.

Again, select "Point" from the pop-up menu by left-clicking on it

With the pick-box over the second point; left-click to select that point

On the command bar **[Close]** to exit the command. Remember that **{ESC}** can also be used to exit the command.

Note: Draw the centerline in the direction of increasing stations, for example, from the left abutment to the right abutment while looking downstream.

Extend the centerline in one or both directions so that it extends beyond the upper contour line. First, view the entire project:

[View]-[All]

Hint: Use the coordinates in the coordinate scroll to estimate the distance to extend the centerline. 125 feet should be enough.

Return to the previous view:

[View]-[Previous view]

Now extend both ends:

[Edit]-[Extend]

Make sure the “To boundary” checkbox is disabled so that a distance can be specified

With the focus in the Distance window; **125**

With the focus in the Line window; Place the pick-box over the centerline near one of the ends, then select the line by left-clicking

On the command bar; **[Extend]**

With the focus in the Line window; Place the pick-box over the centerline near the other end and select the line by left-clicking

On the command bar; **[Extend]**

On the command bar; **[Close]**

View the entire project:

[View]-[All]

5. Clip the contour lines at centerline

First, make the STAGE layer the current layer.

To clip the contours:

[Edit]-[Clip]

With the focus in the Mode window; change the Mode to “Break” either by pressing the letter “B” on the keyboard, or by selecting Break from the list box.

With the focus in the Bound window, leave the select control on Record and select the centerline by left-clicking on it.

With the focus in the Objects window, change the select control to Layer. This can be done by pressing the letter “L” on the keyboard or by right-clicking anywhere in the drawing area and selecting Layer from the select control pop-up menu.

Note: The contours can also be selected individually (Record), by color, by linetype, etc. depending upon what type of select control is specified. After some experience, the user can decide which method works best for them.

Left-click on the button just to the right of the Objects window to bring up the Select by layer(s) dialog box.

Select the STAGE, STAGE_CON, and STAGE_ICON layers. (Remember that you can select multiple objects by holding down **{Ctrl}** while left-clicking on those objects)

Note: The reason for choosing the STAGE layer is so that the breaklines that cross the centerline will be broken along with the contours.

On the Select by layer(s) dialog box; **[OK]**

On the command bar; **[OK]**

6. Erase everything downstream of the centerline

Do not execute the erase command until it has been verified that only the downstream portion of the contour lines and breaklines are in the selection set. Remember that the objects selected turn gray.

Note: Erasing the points downstream of the centerline will not have an adverse affect on the stage-storage table or the original map. Remember that all of the points were copied to the STAGE layer and the rest of the layers were locked. The purpose of erasing everything downstream of the centerline is so that the user has a "cleaner" map to work with.

Warning: Once the points downstream of the centerline have been erased, the STAGE layer cannot be contoured again. If the user makes a mistake and has to re-contour, everything on the STAGE layer should be erased and the user should return to the beginning of this note.

To erase the contours, and breaklines:

[Edit]-[Delete]

Leave the select control on Record and individually select all of the contours, and breaklines downstream of the centerline by left-clicking on them.

On the command bar; **[OK]**

Freshen up the display if necessary by [View]-[Redraw]

If any contours or breaklines were missed the first time, repeat the erasing process until they are all erased.

To erase the points:

[Edit]-[Delete]

Change the select control to Window either by pressing "W" on the keyboard or by right-clicking anywhere in the drawing area and choosing Window from the select control pop-up menu.

Left-click above and to the left of the points

Left-click below and to the right of the points

On the command bar; **[OK]**

Note: The points can also be selected individually by leaving the select control on Record.

After all of the points, contours, and breaklines downstream of the centerline have been erased, view the entire map.

[View]-[All]

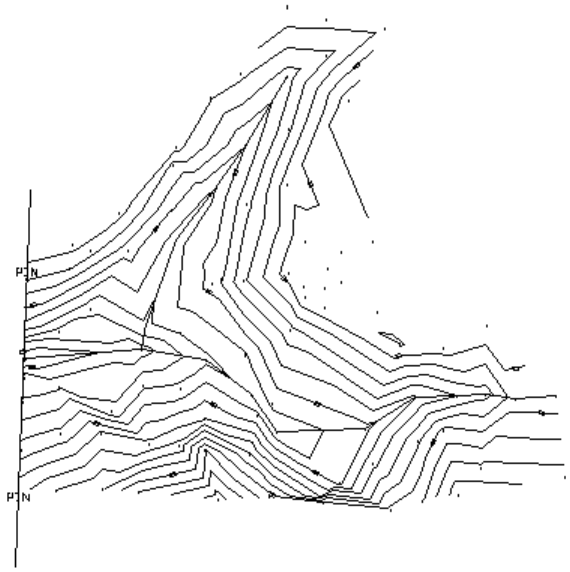

Figure 6-3

7. Erase the points and contours above the desired elevation

First, the point labels for the PIN's must be turned off in order to avoid problems later in the process. To get rid of the point labels, the point must be re-labeled with "nothing".

To turn off the point labels:

[Draft]-[Label points with text]

Change the select control to Name by pressing N on the keyboard or by right-clicking in the drawing area and selecting Name from the select control pop-up menu.

Right click on the button just to the right of the Select control window. This will bring up the Select by name dialog box.

In the Mask window; **PIN** (This is case sensative)

On the Select by name dialog box; **[OK]**

On the command bar; **[Settings]** This will bring up the Point label content dialog box.

Disable all of the check boxes.

On the Point label content dialog box; **[OK]**

On the command bar; **[Label]**

Figure out which contour will be the highest contour in the stage-storage table. In this example, the 72' contour will be the highest contour used.

Note: Make sure that the top contour and all contours below it are continuous lines that terminate at the centerline.

To erase everything above that elevation:

[Edit]-[Delete]

In the Objects window, change the select control to Elevation either by pressing "E" on the keyboard or by right-clicking anywhere in the drawing area and selecting Elevation from the select control pop-up menu.

Left-click on the button just to the right of the Objects window. This brings up the Select by elevation command bar.

In the Elevation from window, type **72.001** (It will appear as 72.00 after the focus is out of this window, but it is actually 72.001)

In the To window, leave the * (asterisk). This puts no upper elevation limit on what is supposed to be erased.

On the command bar; **[OK]** This will take you back to the Delete command bar.

On the command bar; **[OK]** This will erase everything above elevation 72.001 and exit the command.

Note: Breaklines may still appear outside of the top contour. This can be corrected by redrawing the screen using: [View]-[Redraw].

Note: If the point labels were not erased earlier, error messages will appear where the point labels used to be. This is because the point labels are "connected" to the points. If the points are erased, the program doesn't know what to do about the labels. The error messages can be removed using the same process as is used to turn off the point labels. This process was described earlier in this step.

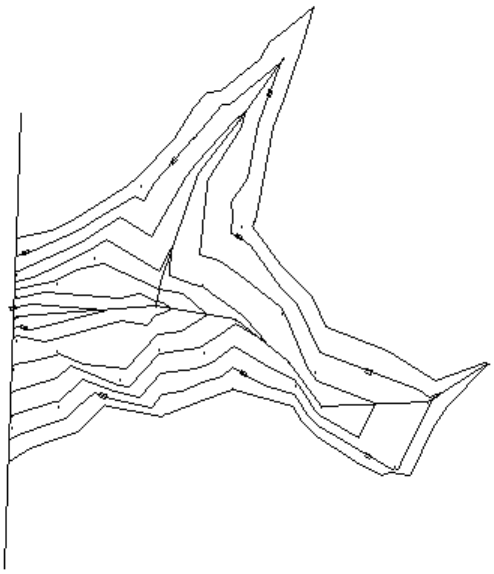

Figure 6-4

8. Close the contour lines along centerline

The CloseFig command can be used to connect two end points of a polyline or set. Since the ends of the contour lines terminate at the structure centerline, they will be closed along the centerline. The CloseFig command is a keyboard only command that works only with “non-smoothed” polylines and sets.

Turn off the visibility of the centerline so each contour line can be seen closing.

On the toolbar; **[L Set]** This will bring up the Layer settings dialog box.

Highlight the CL layer by left-clicking on it.

Disable the Visible checkbox

On the dialog box; **[OK]**

The contours can be closed individually or all at once. The contours can be closed all at once in this example for two reasons: 1) All of the contours that are not needed for the stage-storage table have been erased, and 2) All of the contours are continuous lines that terminate at the centerline.

To close all of the contours at once:

In the command line; **closefig**

Change the select control to Layer either by pressing the letter “L” on the keyboard or by right-clicking anywhere in the drawing area and selecting Layer from the select control pop-up menu.

Left-click on the button just to the right of the Lines window. This will bring up the Select by layer(s) dialog box.

Select both the STAGE_CON and STAGE_ICON layers

On the Select by layer(s) dialog box; **[OK]**

On the command bar; **[OK]**

Hint: Remember that once the select control has been set to Layer, the entire layer can be selected by simply left-clicking on any object that is on that layer. This is a faster way to select layers because it allows the user to bypass the Select by layer(s) dialog box.

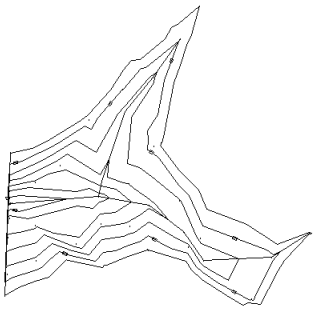

Figure 6-5

To close the contours individually:

Start by closing the lowest contour. For this example, it will be hard to see the lowest contour line because it is a very small area. The user will have to zoom in to see the lowest contour using: [View]-[Zoom]

In the command line; **closefig**

Leave the select control on Record

Select the lowest contour by left-clicking on it

On the command bar; **[OK]**

Repeat the previous command to close the next higher contour.

Hint: The spacebar may be used to repeat the previous command.

Continue to close the remaining contours, working up in elevation so each contour can be seen as it closes.

9. Create a point for use with the Inpond command

First, make sure the current layer is STAGE

To create a point:

[Draw]-Point-[Point]

With the focus in the Location window, left-click on the screen where the point is to be located.

Note: The author recommends placing the point downstream of the centerline. Because everything else downstream of the centerline has been erased, this point will be the only object in the area. This will make the point easy to locate.

The point does not need an elevation or a name.

On the command bar; **[Point]**

On the command bar; **[Close]**

10. Run the Inpond command to define the pond area

Inpond is a keyboard only command that is used to define a pond area by choosing the contours that are in the pond. In other words, the user is using the Inpond command to tell TerraModel that "this pond is made up of these contours". That information is then linked to the point that was created in the previous step. Therefore, that single point represents the entire pond.

To run the Inpond command:

In the command line; **inpond**

A dialog box will appear that states "The PondVol attribute could not be found. Do you want to load the corresponding attribute definition file." On that dialog box; **[Yes]**

With the focus in the Pond window, select the point that was created in the previous step.

With the focus in the Contours window, change the select control to Layer.

Right-click on the button just to the right of the Contours window to bring up the Select by layer(s) dialog box.

Highlight the STAGE_CON and STAGE_ICON layers

On the dialog box; **[OK]**

On the command bar; **[Inpond]**

A dialog box will appear stating “The pond volume attribute is not assigned to this point. Do you want to assign the attribute?” On the dialog box; **[Yes]**

On the command bar; **[Cancel]** This will exit the command.

WARNING: When selecting contours for the stage-storage table by layer, there are two potential problems: 1) Selecting contours that are not to be part of the stage-storage table, and 2) Isolated peaks or depressions in the pond area. TerraModel currently cannot handle isolated peaks and depressions. If the peaks and depressions are selected with the rest of the contours, the calculated stage-storage table will be incorrect. This is a flaw in the program that the agency has requested be fixed. Until another command is available to determine stage-storage, the user must be very careful when there are isolated peaks or depressions in the pond area.

If peaks and depressions are present in the pond area, they must be “un-isolated” by manually inserting a dike or a ditch (maybe 0.1’ wide) connecting the isolated peak or depression contours to the main contours.

If the isolated peaks or depressions are small enough that they are insignificant, they may be ignored. The engineer must measure the area of the peak and depression contours separately and determine if their volume is significant. If it is determined that their volume is significant, they must be added to the stage-storage table manually. The area of a closed contour can be measured using [Inquire]-[Area/Perimeter].

To create a stage-storage table that excludes peaks and depressions, the user can individually select (by Record) the contours that are to be part of the table. Also, the user could select all of the contours by layer, and then exclude the peak and depression contours using the AND NOT logical operator in the select control pop-up menu.

11. Calculate the stage-storage table using the Pond Volume command

The Pond Volume command uses the pondvol.tml file, which resides in the main TerraModel directory (probably TMW32). The original pondvol.tml uses ft^2 for area units and ft^3 for volume units. This file has been altered to display area in acres and volume in acre-feet. The altered pondvol.tml can be found on the FTP server with the TerraModel Notes. This file will have to be downloaded and placed in the correct directory (probably TMW32) so that the original pondvol.tml is overwritten.

Note: The location of pondvol.tml may be changed in the future so that it won't be overwritten when the software is upgraded. All TerraModel users will be notified if pondvol.tml is to be moved.

To calculate the stage-storage table using the Pond Volume (PondVol) command:

[Hydro]-Ponds-[Pond volume]

With the focus in the pond window; select the point that was created in Step 9 by left-clicking on it. Remember that this point represents the pond.

Note: The Name button can be used to name the pond. It is not necessary to name the pond, but it may be useful if there are multiple ponds in the same project.

On the command bar; **[List]**

A text editor (probably P3Pad) will appear displaying the stage-storage table. This document can be manipulated, saved, or printed in the same way as any other document.

PROJECT: C:\My Documents\Jason\TM Notes\Working\TMnoted\chapter6.working

HYDROLOGIC REPORT - POND DEPTH VS STORAGE PROVIDED
POND: 000

ELEV feet	DEPTH feet	AREA acres	VOLUME ac-ft	SUMVOL ac-ft
58.0		0.0		0.0
	2.0		0.1	
60.0		0.1		0.1
	2.0		0.3	
62.0		0.2		0.3
	2.0		0.8	
64.0		0.6		1.1
	2.0		1.5	
66.0		0.9		2.6
	2.0		2.7	
68.0		1.7		5.2
	2.0		4.5	
70.0		2.8		9.8
	2.0		6.5	
72.0		3.7		16.3

Figure 6-6